CENTER

Influence of Plowing And Cultivation on the Moisture Content of Soil

Agronomy
B. S.
1905

INFLUENCE OF PLOWING AND CULTIVATION ON THE MOISTURE CONTENT OF SOIL

BY

ORLO DORR CENTER

Thesis for the Degree of Bachelor of Science
in Agronomy

COLLEGE OF AGRICULTURE
UNIVERSITY OF ILLINOIS

1905

UNIVERSITY OF ILLINOIS

MAY 26, 190 6.

THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

ORLO DORR CENTER

ENTITLED INFLUENCE OF PLOWING AND CULTIVATION ON THE

MOISTURE CONTENT OF SOIL.

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF BACHELOR OF SCIENCE

Cyril G. Hopkins

HEAD OF DEPARTMENT OF AGRONOMY

Influence of Plowing and Cultivation on the moisture Content of Soil.

Plan and Object of the Work.

In the following experiment the plan of the work was to have twenty-six plots, each twelve feet wide by one hundred and thirty-two feet long, containing approximately one twenty fifth of an acre. It was the intention to plow one plot in the fall and the others at stated periods during the spring. This scheme was followed out almost exactly as planned, except, that the weather turned cold suddenly and froze the ground so hard that it was impossible to plow a plot in the fall for the special purpose desired. There had been, however, an acre of ground fall plowed eight rods away from the series of plots selected for the experiment, and it was decided to use a portion of this fall plowing for the plot of this sort.

The object of the experiment was to ascertain the effect of time and depth of plowing upon the moisture content of the soil during the entire growing season. It was also purposed to ascertain the effect of frequency and depth of cultivation upon the moisture content of the soil during the growing season. It was also desired to find the effect of different methods of oats seeding on the moisture content of the soil, as well as the effect on the moisture content, when clover was seeded with the oats. Although the ascertainment of the moisture content of the plots under the various conditions was the chief object of the experiment, the effect of the different conditions supplied, upon the yield and quality of the crop produced on the several plots has also been noted.

The plots used in this experiment were all situated on the south division of series 600 and 700 of the North Exp.Farm, except

Plate 1.

Check Plot.
Plot II Plowed April 20 6 inches deep

Sod Division

Sod Division

Plot I Fall Plowed About Aug. 1 1903

Sod Division

Sod Division

Sod Division

Plot III A.	Plowed April 14 3 inches deep
Plot III B.	Plowed April 14 6 inches deep
Plot III C.	Plowed April 14 9 inches deep
Plot IV A.	Plowed April 23 3 inches deep
Plot IV B.	Plowed April 23 6 inches deep
Plot IV C.	Plowed April 23 9 inches deep
Plot V A.	Plowed April 30 3 inches deep
Plot V B.	Plowed April 30 6 inches deep
Plot V C.	Plowed April 30 9 inches deep
Plot VI A.	Plowed May 14 3 inches deep
Plot VI B.	Plowed May 14 6 inches deep
Plot VI C.	Plowed May 14 9 inches deep
Plot VII	Oats sown broadcast April 23
Plot VIII	Oats Drilled April 23
Plot IX	Oats drilled with clover April 23
Plot X	Oats broadcast with clover April 23

Plot XI A.	Cultivated, 3 inches deep every 5 days.
Plot XI B.	Cultivated 6 inches deep every 5 days
Plot XII A.	Cultivated 3 inches deep every 10 days
Plot XII B	Cultivated 6 inches deep every 10 days
Plot XIII A.	Cultivated twice 3 inches deep
Plot XIII B.	Cultivated twice 3 inches deep
Plot XIV A.	Check plot 3 inches deep
Plot XIV B.	Check plot 6 inches deep.

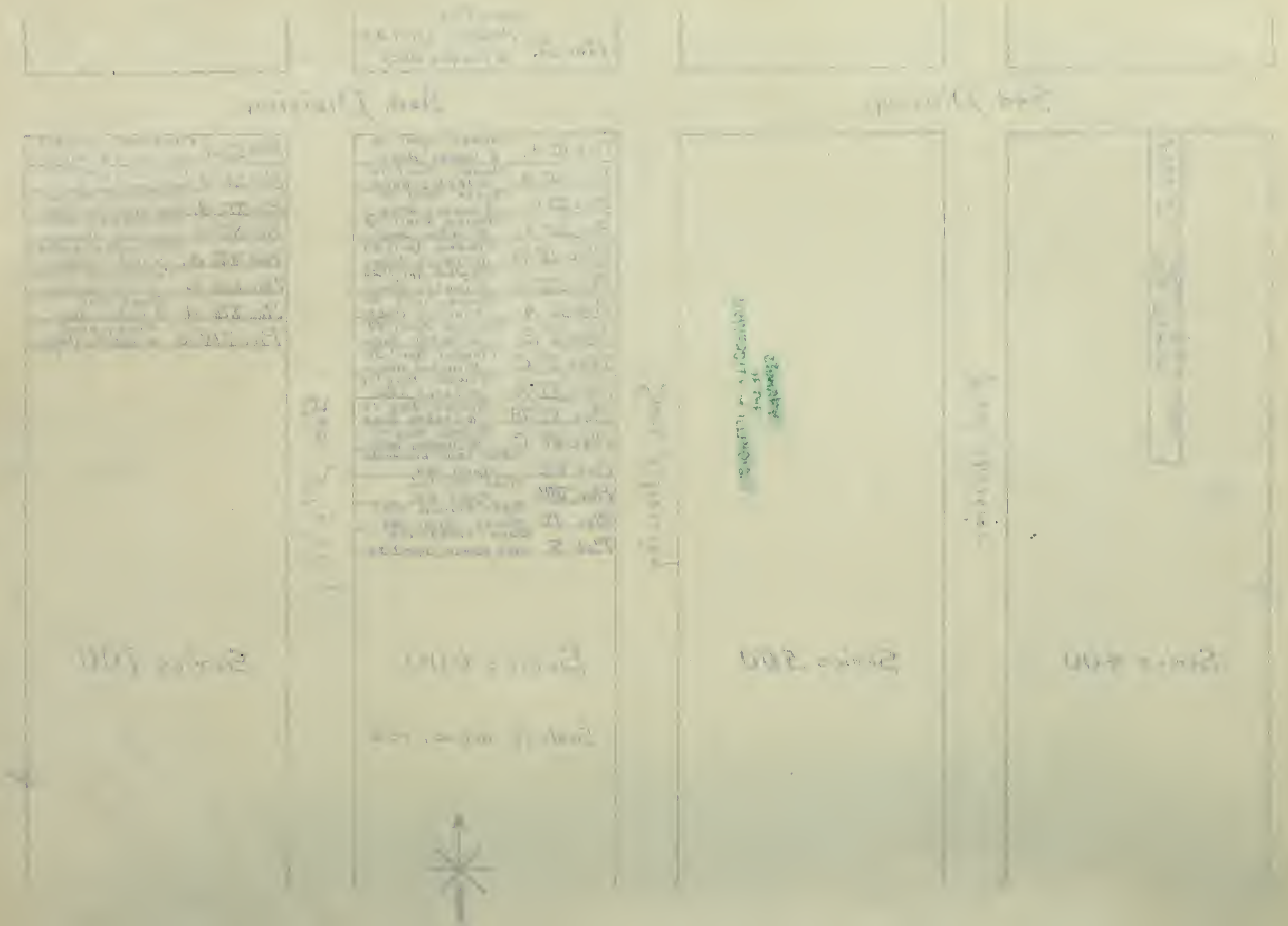
Series 400

Series 500

Series 600

Series 700

Scale 1/4 inch = 1 rod.



Section 500
Section 400

Plate 3.

UNIVERSITY OF ILLINOIS
AGRICULTURAL EXPERIMENT STATION

Investigation of Illinois Soil.
BY
CYRIL G. HOPKINS

GENERAL SURVEY

SOIL MAP OF ILLINOIS

(CHIEFLY AFTER F. LEVERETT'S GLACIAL MAP.)

the plot where the ground was fall plowed; this plot was on the south division of 400 series of the North Exp.Farm. The plots were numbered in the order in which they lay from west to east. Plot No.1 was the one situated farthest toward the north-west and plot 14 B farthest toward the south-east. Plate No.1 shows the number and arrangement of the plots.

General description of the Soil.

The plots under investigation are located on the Champaign Moraine, one of the Moraines of the Early Wisconsin Glaciation. (1) The location of this moraine is shown on the General Syrvey Soil Map of Illinois. (2)

The type of soil on which the plots are situated has been described under the name of brown silt loam of the Early Wisconsin Glaciation in Illinois Investigation. It is classified as Marshall silt loam by the Bureau of Soils, Department of Agriculture. (3)

The soil consists of a dark brown silty loam containing a considerable amount of organic matter. The organic matter gives to the soil the dark color, causes it to be slightly granular, tends to increase the absorptive power and water holding capacity, helps the capillary movement of water, and gives it a some what more loamy character than might be expected in a soil of the texture shown by the mechanical analysis.

The soil is quite porous. Because of this porosity and the organic matter it contains, rain water is readily absobed and is retained for the use of the crops.

1.Monograph Number 38. United States Geological Survey, Page 223.
2.Circular No.68, University of Illinois and Agricultural Experiment Station.
3.Field Operations of the Bureau of Soils 1903.

The productiveness of this soil is probably increased by the power which it has of absorbing and retaining moisture.

The color of the soil varies with the amount of organic matter contained and the amount of organic matter varies with the topography. The slopes, subject to slight washing, contain less organic matter and are lighter in color than the soil of lower lying areas and of depressions or level areas. The surface soil, when wet, is slightly coherent, but when only moist it crumbles and pulverizes readily, unless it has been tramped by livestock or has been worked under unfavorable conditions.

The depth of the top soil varies some what with the topography, being deeper where the surface is level and in the depressions, and shallower where the surface is more rolling. On the rolling portions of the moraines and along the streams sometimes the top soil is not more than ten inches in depth, but usually it is sixteen to eighteen inches deep. The depth varies on the plots under investigation as will be seen by comparing the borings of the separate plots. Occasional bowlders and some gravel are found on the surface, especially on the higher moraines. On the level areas however, the loess, or loess-like silt, is usually more than forty inches deep and overlies the glacial till.

The subsoil is a mottled yellow, clayey silt in which the silt is the most prominent constituent. The subsoil is not distinctly marked from the soil, but the change from soil to subsoil is gradual, and usually changes within four to six inches. The mottling of the yellow subsoil is due to decaying roots of plants, and to iron oxide. The mottled yellow clayey silt is commonly called CLAY, but it does not have the heavy, plastic, character of true clay.

It is usually somewhat plastic, however, especially when moist. The plasticity of the subsoil decreases with the depth and at forty inches it may be silt with but a very little clay. Often the subsoil is quite friable, and checks into irregular cubes when exposed to the action of water and air. Because of this property the subsoil when tile-drained becomes very porous, and allows moisture and air to pass through it readily.

Detail description of the soil of the plots.

An examination of the surface soil, sub-surface soil and subsoil of the plots where moisture determinations were made, showed that there were variations in the physical condition which perhaps would influence the moisture content of the soil, especially during a season of little rainfall. The examination also showed that there was some variation of soil and subsoil even on the same plot.

Borings from Plot 2.

Although the surface of this series of plots is such that there is good surface drainage, yet plot 2 and 3 A.B.and C. are so located that parts of each plot have caught the wash from the higher lying soil and the surface soil is some deeper and contains more clay and organic matter than the other plots. The soil on the west end of plot 2 had a very little gravel on the surface and contained a small amount of medium and fine sand mixed through the soil and subsoil. The top soil contained a large amount of organic matter, was slightly granular and was 21 inches deep. The subsoil was drabbish yellow, indicating poorer drainage than the plots farther south. The soil on the east end of this plot contained more clay and more organic matter than the surface soil on the west end of the plot. The dark top soil was 34 inches deep showing that there had been more silt and organic

matter carried from the higher land and deposited on this end of plot. Because of this difference in depth of brown silt loam the physical condition was different from those parts where the brown soil was only 21 inches deep.

Boring from Plot 3 B.

Boring same as first except in depth of soil. Top soil 24 inches deep.

Boring from Plot 5 A.

The top soil at the west end of this plot was 18 inches deep. Subsoil brighter yellow, which indicates better drainage than that of the plots before described. Soil at the center of the plot contains occasional gravel and some fine sand. Top soil was 22 inches deep. Soil at the east end of this plot was noticeably heavier, that is contained more clay, was darker in color, and was slightly granular. The brown soil was 36 inches deep. The brown soil of the plot was more variable than on any other plot ranging from 18 to 36 inches deep, and because of this the physical condition probably was sufficiently different in the different parts of the plot to influence the moisture content.

Boring from Plot 7.

The top soil of plot 7 was much lighter in color than that of the preceding indicating less organic matter. The subsoil was in a dryer condition than the subsoil of the other plots, and contained less fine silt and clay. The east end of the plot was in the same condition as the west end indicating that there was but a slightly different physical condition of the subsoil of this plot.

Boring from Plot 10.

Brown soil 22 inches deep. The subsoil at the west end was

compact and not so friable as the subsoil of plot 7. Subsoil of the east end was friable and not so compact.

The plots used for the cultivation experiment are very similar to Plots 3 B and 5 A, since they lie on nearly the same level and have the same drainage.

Detail description of the plots.

Plot 1 was wheat stubble plowed about Aug.1.1903 to a depth of six inches. It turned up rather lumpy and dry but mellowed down during the winter and was in excellent shape when disked April 30. After disking there was nothing further done to the plot until May 18 when it was dragged and harrowed thus fitting it for planting. This plot together with all the others, was planted May 21, three kernels in a hill, hills three feet apart each way. On June 4 the corn was thinned to two stalks to the hill. The first cultivation was given on June 14, and after this the plots, except those in the cultivation experiments, received two cultivations during the season. The corn was cut and shocked on October 1, and was husked and weighed on October 29. The yield was computed at eighty pounds per bushel. The corn grown on plots 1 to 6 C inclusive was Illinois High Oil, and on the other plots Leaming was grown.

Plot 2 was disked, as were all the other plots in the experiment, on April 11. It was plowed six inches deep on April 20, and at once dragged. On May 18, the plot was harrowed twice and fitted for planting. It was planted May 21, as already described under plot 1. This plot received the same treatment all through the season as the regular fields of the Experiment Station. The cutting, shocking, husking and weighing, for all the plots was at the same time as for plot 1. Plots 3 A, 3 B, and 3 C had the same treatment

before plowing as plots 1 and 2. They were plowed April 14, at a depth of three, six, and nine inches respectively. After plowing they were handled the same as the other plots. Plots 4 A, 4 B, and 4 C were treated exactly as the preceding except that the time of plowing was April 23 and plots 5 A, 5 B, and 5 C were plowed April 30 and plots 6 A, 6 B, and 6 C were plowed May 14. Aside from the time of plowing there was no difference in the treatment of any of the foregoing plots. Plots 7, 8, 9, and 10 were not plowed. They were all thoroughly disked and the oats sown with a Superior disk drill at the rate of two bushels per acre on plots 8 and 9 and by hand at the same rate per acre and then harrowed in thoroughly on 7 and 10. The clover on both 9 and 10 was sowed by hand, on 9 ahead of the drill and on 10 ahead of the harrow. Plots 11 A to 14 B inclusive were all treated alike except in the matter of cultivation. They were all disked on April 9, plowed April 20 and planted on May 21. Plots designated as A in the cultivation experiments were all cultivated three inches deep; those marked B were all cultivated six inches deep, plots 11 A and 11 B were cultivated every five days beginning June 14, and ending July 15. Plots 12 A, 12 B were cultivated every ten days beginning June 14, and ending July 25. Plots 13 A, and 13 B were cultivated June 14, and July 14, while the two remaining plots were cultivated three times during the season, or at the same times as the regular experiment fields.

These plots were cut, shocked, husked and weighed at the same time as those already given. The oat plots were cut July 26 and thrashed Aug.4.

Method of collecting samples and of determining the moisture content.

In planning the experiment it was thought best to collect the samples once each week, and Saturday was the day selected for the purpose. Samples of the soil of the plots under experiment were taken according to the method of division of the soil as adopted in this state. This method is the dividing of the soil into top soil and subsoil, the top soil being further divided into surface and sub-surface. The surface soil extends to a depth of about seven inches, or to the depth to which the ground is ever likely to be plowed. The sub-surface soil includes that from the surface soil to the subsoil or from the plow line to where the change in character, usually color and texture, takes place. (commonly 7 to 18 inches with this type). There is a gradation of sub-surface into subsoil and about two inches of this intermediate soil is thrown away. The subsoil was sampled to a depth of 36 inches.(20 to 36 inches).

The auger, which has come into almost universal use for taking soil samples and which is simply an ordinary two inch auger with an extension making it 40 inches long, was used.

Having located the spot in the plot where the sample was to be taken the surface was first tramped down in order to firm the soil sufficiently so that it could be lifted out on the auger. One or two turns of the auger forced it into the ground to the proper depth for the surface sample. It was then carefully lifted out and the soil placed in the glass jar provided for the purpose. After the surface soil had been secured the auger was worked up and down in the hole to enlarge it sufficiently so that the sub-surface sample could be with drawn without coming in contact with the surface soil. The bottom of

the hole was then cleaned out by carefully turning the auger to just the depth previously reached, and the soil with drawn was discarded. The auger was then carefully cleaned of any adherent surface soil and the sub-surface sample secured. The operation of enlarging and cleaning the hole was repeated although this time the intermediate two inches between the sub-surface and the subsoil is removed and rejected with the cleanings. The sample of subsoil was then taken to a depth of 36 inches.

As soon as a sample of soil was taken from a plot it was at once placed in a glass jar and the lid tightly screwed on. As but a few seconds elapsed between the removal of the soil from the auger until it was tightly sealed in the jars there was, no appreciable amount of moisture lost. Each jar was labeled with the number of the plot, the number of the collection, the division of soil, and the date when collected.

The labels were changed with every collection and in this way all mistakes in plot, soil, collection, or date, was avoided. A label would read,

Plot 4 A
7th. Collection
Sub-surface
5 / 14 / '04

As there were three divisions of the soil it was necessary, of course, to have three jars for each plot; thus, when samples were collected from all the plots there were seventy two jars used. Plate 2 shows the auger, jars, and tray used in collecting, and removing the soil from the field.

The jars, as soon as the samples were collected from all

the plots, were carried to the soil physics laboratory and here arranged in regular order, beginning with plot one and continuing on throughout the entire series. This arbitrary arrangement was adopted to facilitate the work of weighing out the samples, since the method used in determining the moisture content was the gravimetric method.

As soon as possible after the soil reached the laboratory there were two samples, of 100 grams each carefully weighed from each jar. These 100 gram samples were weighed out on an analytical balance and all weights were taken to the hundredths of a gram. Before weighing out samples from a jar, it was shaken thoroughly, thus giving as uniform a sample as was possible to secure. All the samples were weighed out into small tin pans, and allowed to stand at room temperature until the weight became constant. As soon as the duplicate samples were weighed the jar was emptied, washed, and relabeled and the pans containing the samples, which were also labeled to corrospond to the jar, were placed in regular order on shelves.

The samples of soil obtained from several of the earlier collections were weighed every other day until their weight became constant, but after having weighed some three hundred samples in this way it was discovered that the soil had lost its capillary moisture at the end of ten days. The practice of weighing every other day was therefore discontinued. From this time on all the samples were allowed to stand in the laboratory fourteen days after the first weighing, before they were reweighed. A comparison of figures showed that this latter method gave equally as accurate results as the method first employed and when the fact is taken into consideration that over three thousand samples were weighed during the season, some idea of the saving of labor can be arrived at.

As soon as a weighing was made the weight was recorded in a book especially ruled and prepared for the purpose. To show more clearly the method of recording the samples and the weights the following portion of a page of the book is given.

No. of Pan	Division of Soil			Remarks
	Surface	Sub-surface	Subsoil	
1153	189.85			Plot 11 A
1154	201.47			7th. Collection
1155		189.50		Collected 7 / 9
1156		186.53		First Weighing
1157			191.58	7 / 9 / '04
1158			185.68	
1153	168.64			
1154	180.17			
1155		171.20		Second Weighing
1156		168.08		7 / 23 / '04
1157			173.74	
1158			166.92	

From the air dried samples of soil ten grams were taken and placed in crucibles, previously weighed, and these were then placed in an oven and kept at a temperature of 110°C. for seven hours. At the end of this time they were removed from the oven, placed in a desiccator and allowed to cool. They were then reweighed and from the loss in weight the amount of hygroscopic moisture was determined. The results obtained in all this experiment indicate the total moisture content of the plots represented, that is, both the capillary and hygroscopic moisture of the soil.

All the results given of the moisture content of the different plots are shown as per cent of the --WATER FREE SOIL, rather than as per cent of air dry soil.

Table 1 showing per cents of moisture in the SURFACE soil of plots plowed on different dates. Plots 1 and 2 plowed 6 inches deep. All others 3 inches.

Date of Collection	Plot 1 Fall Plowed	Plot 2 Plowed Apr.20.	Plot 3 A Plowed Apr.14.	Plot 4 A Plowed Apr.23.	Plot 5 A Plowed Apr.30.	Plot 6 A Plowed May.14.
Apr.13			17.80			
" 20		17.73	12.37	15.21		
" 29		17.21	16.70	13.55	15.90	
May 5		16.38	16.00	13.70	15.79	
" 14		15.49	14.85	15.68	14.68	14.63
" 21	17.15	16.19	13.76	16.35	17.87	19.31
June 6	15.41	13.82	14.00	14.87	16.32	15.92
" 11	18.00	15.19	15.39	15.04	19.94	18.81
" 18	23.56	19.91	18.64	20.60	20.01	18.27
" 25	16.78	13.39	14.68	14.30	13.93	13.50
July 2	22.23	15.67	17.96	16.84	16.69	17.56
" 9	15.63	14.47	16.36	16.66	17.06	17.17
" 16	19.77	17.85	20.62	19.23	19.74	18.94
" 30	15.03	11.96	13.49	11.47	11.43	10.98
Aug. 6	12.71	10.63	11.55	10.73	13.34	14.80
" 13	16.43	12.57	11.76	12.78	11.44	11.69
" 20	16.95	11.32	14.58	15.43	14.25	14.60
" 27	16.30	13.39	13.62	19.02	19.77	19.15
Sept.3	20.60	16.37	18.02	14.23	14.92	13.08
" 10	21.74	16.10	12.94	12.54	12.88	11.87
" 17	16.09	17.56	14.87	16.36	17.93	15.68
" 24	24.76	19.79	15.59	20.57	22.16	20.81
Average per cent	18.18	15.07	15.16	15.71	16.45	15.97

Table 2 showing per cents of moisture in the SUB-SURFACE soil of plots plowed on different dates. Plots 1 and 2 plowed 6 inches deep. All others 3 inches deep.

Date of Collection	Plot 1 Fall Plowed	Plot 2 Standard Plowed Apr.20	Plot 3 A Plowed Apr.14	Plot 4 A Plowed Apr.23	Plot 5 A Plowed Apr.30	Plot 6 A Plowed May.14.
Apr.13			15.29			
" 20		16.41	13.79	14.55		
" 29		16.75	14.94	14.19	14.56	
May 5		15.56	13.36	13.74	14.62	
" 14		14.89	14.64	14.28	13.88	13.81
" 21	14.92	14.67	13.99	18.63	18.41	16.55
June 6	12.59	13.57	13.62	13.45	14.10	17.85
" 11	14.46	13.78	15.21	13.65	19.67	18.72
" 18	16.93	17.47	18.30	19.24	18.34	18.87
" 25	13.73	14.16	13.28	13.34	14.16	14.35
July 2	17.99	16.21	17.77	15.71	17.12	18.27
" 9	13.42	13.76	15.15	14.15	14.70	14.17
" 16	16.74	16.19	18.99	17.70	18.33	17.81
" 30	14.99	14.27	14.40	12.40	13.34	12.89
Aug. 6	11.64	10.68	12.06	11.50	14.40	14.80
" 13	14.27	13.96	13.35	12.61	12.52	13.77
" 20	11.38	12.68	10.80	10.59	13.80	10.36
" 27	13.24	10.38	11.12	14.83	17.43	13.83
Sept.3	15.15	13.31	14.12	10.63	12.94	11.12
" 10	19.62	14.61	11.49	11.24	10.35	10.75
" 17	12.73	12.81	13.88	14.35	12.47	12.43
" 24	16.18	14.87	13.21	17.62	14.52	15.28
Average	14.70	13.96	14.16	14.21	15.09	14.81

Table 3 showing per cents of moisture in the SUBSOIL of plots plowed on different dates. Plots 1 and 2 plowed 6 inches deep. All others 3 inches deep.

Date of Collection	Plot 1 Fall Plowed	Plot 2 Standard Plowed Apr.20	Plot 3 A Plowed Apr.14.	Plot 4 A Plowed Apr.23.	Plot 5 A Plowed Apr.30	Plot 6 A Plowed May 14
Apr.13			12.87			
" 20		14.12	12.41	12.20		
" 29		14.07	13.09	13.89	13.26	
May 5		13.69	12.77	13.89	13.33	
" 14		12.85	13.68	13.30	13.02	12.96
" 21	14.03	11.82	13.09	16.59	16.71	17.31
June 6	11.38	13.12	13.48	13.33	15.30	18.25
" 11	15.09	13.71	13.48	13.34	16.84	17.03
" 18	16.64	18.51	18.91	18.51	19.10	17.64
" 25	12.68	12.83	13.03	12.96	13.55	14.59
July 2	17.75	16.54	16.68	16.66	16.99	17.25
" 9	13.21	13.66	14.48	14.13	14.71	13.95
" 16	17.11	16.30	17.33	17.34	16.44	17.44
" 30	16.79	17.40	14.91	12.61	12.79	14.02
Aug. 6	13.15	12.53	13.48	13.16	15.28	16.14
" 13	18.74	17.29	15.30	11.87	12.52	13.14
" 20	11.32	10.28	10.74	11.35	13.81	12.43
" 27	14.59	11.12	10.63	15.24	14.33	13.83
Sept.3	15.53	13.19	16.13	12.18	12.47	11.84
" 10	19.73	13.33	10.67	10.75	10.20	11.26
" 17	12.09	12.69	11.91	13.63	13.47	12.81
" 24	15.09	13.38	12.82	14.51	14.12	14.09
Average	15.00	13.98	13.94	14.01	14.62	14.88

Table 4 showing per cents of moisture in the SURFACE soil of plots plowed at different dates. All plots plowed 6 inches deep.

Date of Collection	Plot 1 Fall Plowed	Plot 2 Standard Plowed Apr.20	Plot 3 B Plowed Apr.14.	Plot 4 B Plowed Apr.23	Plot 5 B Plowed Apr.30	Plot 6 B Plowed May 14
Apr.13			17.73			
" 20		17.73	14.77	13.62		
" 29		17.21	17.25	15.77	15.83	
May 5		16.38	16.96	15.11	15.13	
" 14		15.49	16.88	13.86	16.49	13.63
" 21	17.15	16.19	17.86	19.97	13.26	18.20
June 6	15.41	13.82	16.39	12.22	15.21	18.68
" 11	18.00	15.19	15.71	19.63	19.76	17.99
" 18	23.56	19.91	20.82	20.16	19.63	18.16
" 25	16.78	13.39	15.48	14.21	14.31	13.71
July 2	22.23	15.67	17.79	12.68	17.34	15.03
" 9	15.63	14.47	14.98	17.29	17.23	14.77
" 16	19.77	17.85	17.91	19.36	17.51	16.95
" 30	15.03	11.96	10.65	11.89	10.25	10.15
Aug. 6	12.71	10.63	10.51	12.87	13.41	13.00
" 13	16.43	12.57	13.14	11.55	11.81	11.89
" 20	16.95	11.32	14.71	18.81	16.50	15.85
" 27	16.30	13.39	15.61	19.60	18.49	17.65
Sept.3	20.60	16.37	15.41	15.14	14.80	11.12
" 10	21.74	16.10	13.37	13.09	13.63	11.52
" 17	16.09	17.56	16.49	17.52	15.68	10.87
" 24	24.76	19.79	20.37	21.50	19.60	21.50
Average	18.18	15.07	15.72	16.32	15.79	15.12

Table 5 showing per cents of moisture in the SUB-SURFACE soil of plots plowed at different dates. All plots plowed 6 inches deep.

Date of Collection	Plot Fall Plowed	Plot 2 Standard Plowed Apr.20	Plot 3 B Plowed Apr.14	Plot 4 B Plowed Apr.23	Plot 5 B Plowed Apr.30	Plot 6 B Plowed May 14
Apr.13			16.41			
" 20		16.41	13.35	15.31		
" 29		16.75	15.71	14.32	15.28	
May 5		15.56	14.64	14.43	16.25	
" 14		14.89	14.38	14.08	15.18	14.48
" 21	14.92	14.67	16.84	17.42	13.98	18.33
June 6	12.59	13.57	14.91	14.70	15.07	18.30
" 11	14.46	13.78	14.70	19.09	18.12	17.66
" 18	16.93	17.47	18.61	19.06	19.58	20.01
" 25	13.73	14.16	13.94	14.62	15.11	15.26
July 2	17.99	16.21	17.07	16.69	18.21	17.26
" 9	13.42	13.76	14.93	16.20	15.03	13.87
" 16	16.74	16.19	18.39	17.04	17.66	19.17
" 30	14.99	14.27	11.72	13.41	13.21	11.76
Aug. 6	11.64	10.68	10.43	12.99	14.26	15.56
" 13	14.27	13.96	12.84	12.78	13.97	13.70
" 20	11.38	12.68	10.23	12.71	13.03	10.60
" 27	13.24	10.38	10.89	17.13	13.79	13.40
Sept.3	15.15	13.31	13.21	12.68	12.80	14.26
" 10	19.62	14.61	10.66	11.04	11.99	10.37
" 17	12.73	12.81	15.00	13.64	14.85	12.47
" 24	16.18	14.87	19.87	19.62	14.28	16.81
Average	14.70	13.96	14.36	15.34	15.00	15.22

Table 6 showing per cents of moisture in the SUBSOIL of plots plowed on different dates. All plots plowed 6 inches deep.

Date of Collection	Plot 1 Fall Plowed	Plot 2 Standard Plowed Apr.20	Plot 3 B Plowed Apr.14	Plot 4 B Plowed Apr.23	Plot 5 B Plowed Apr.30	Plot 6 B Plowed May 14
Apr.13			14.12			
" 20		14.12	12.87	13.08		
" 29		14.07	13.62	13.64	15.23	
May 5		13.69	13.40	13.02	13.80	
" 14		12.85	13.45	13.80	12.44	13.56
" 21	14.03	11.82	14.22	17.13	14.57	13.49
June 6	11.38	13.12	14.25	14.44	14.15	16.39
" 11	15.09	13.71	13.45	17.19	16.81	17.48
" 18	16.64	18.51	19.97	19.55	18.91	18.06
" 25	12.68	12.83	14.51	13.59	13.64	14.55
July 2	17.75	16.54	16.74	16.59	17.06	17.78
" 9	13.21	13.66	12.75	14.37	14.23	15.94
" 16	17.11	16.30	17.97	17.11	17.72	17.70
" 30	16.79	17.40	13.97	14.05	13.05	13.17
Aug. 6	13.15	12.53	12.93	14.96	16.31	15.37
" 13	18.74	17.29	17.08	14.40	13.83	18.96
" 20	11.32	10.28	10.83	12.78	12.95	11.01
" 27	14.59	11.12	11.00	15.18	14.46	13.89
Sept.3	15.53	13.19	14.83	12.64	11.47	11.60
" 10	19.73	13.33	11.51	11.01	10.41	9.75
" 17	12.09	12.69	12.84	12.39	13.59	13.35
" 24	15.09	13.38	13.18	15.27	14.67	16.11
Average	15.00	13.98	14.24	14.86	14.58	14.97

Table 7 showing per cents of moisture in the SURFACE soil of plots plowed on different dates. Plots 1 and 2 plowed 6 inches deep. All others 9 inches deep.

Date of Collection	Plot Fall Plowed	Plot 2 Standard Plowed Apr.20	Plot 3 C Plowed Apr.14	Plot 4 C Plowed Apr.23	Plot 5 C Plowed Apr.30	Plot 6 C Plowed May 14
Apr.13			17.84			
" 20		17.73	16.78	15.18		
" 29		17.21	16.96	16.45	14.37	
May 5		16.38	17.79	16.84	15.76	
" 14		15.49	18.01	15.79	14.67	14.65
" 21	17.15	16.19	13.99	17.65	19.58	13.63
June 6	15.41	13.82	15.27	16.50	14.15	18.50
" 11	18.00	15.19	16.20	15.81	20.02	18.65
" 18	23.56	19.91	20.73	20.00	20.23	17.35
" 25	16.78	13.39	16.30	14.52	14.52	13.33
July 2	22.23	15.67	19.40	19.17	16.44	16.69
" 9	15.63	14.47	16.00	17.33	17.00	16.36
" 16	19.77	17.85	20.53	20.52	19.54	18.41
" 30	15.03	11.96	10.51	12.81	11.80	11.28
Aug. 6	12.71	10.63	11.09	14.67	13.76	9.74
" 13	16.43	12.57	12.98	12.41	11.68	11.69
" 20	16.95	11.32	16.47	16.01	16.31	13.98
" 27	16.30	13.39	20.01	19.29	18.87	18.62
Sept.3	20.60	16.37	13.77	14.36	15.33	13.25
" 10	21.74	16.10	13.03	13.14	12.07	11.77
" 17	16.09	17.56	14.69	17.46	15.82	15.73
" 24	24.76	19.79	21.20	22.03	21.12	20.09
Average	18.18	15.07	16.01	16.68	16.36	15.24

Table 8 showing per cents of moisture in the SUB-SURFACE soil of plots plowed on different dates. Plots 1 and 2 plowed 6 inches deep. All others 9 inches deep.

Date of Collection	Plot 1 Fall Plowed	Plot 2 Standard Plowed Apr.20	Plot 3 C Plowed Apr.14	Plot 4 C Plowed Apr.23	Plot 5 C Plowed Apr.30	Plot 6 C Plowed May 14
Apr.13			15.84			
" 20		16.41	15.01	13.69		
" 29		16.75	15.33	13.74	17.06	
May 5		15.56	14.62	15.51	13.21	
" 14		14.89	14.27	12.37	14.19	14.59
" 21	14.92	14.67	13.26	17.78	18.80	17.81
June 6	12.59	13.57	12.53	13.37	15.61	18.76
" 11	14.46	13.78	15.16	14.73	18.85	17.83
" 18	16.93	17.47	17.92	18.52	18.73	18.15
" 25	13.73	14.16	14.35	14.28	14.18	14.28
July 2	17.99	16.21	17.70	18.56	17.70	16.53
" 9	13.42	13.76	14.28	14.39	13.21	14.10
" 16	16.74	16.19	17.89	18.20	19.66	18.54
" 30	14.99	14.27	11.64	11.94	11.76	12.82
Aug. 6	11.64	10.68	11.39	14.31	14.83	11.30
" 13	14.27	13.96	12.88	13.63	13.89	14.01
" 20	11.38	12.68	10.23	12.89	13.78	10.67
" 27	13.24	10.38	13.93	13.72	15.87	15.62
Sept.3	15.15	13.31	10.97	11.40	12.62	10.71
" 10	19.62	14.61	12.26	10.72	10.50	10.70
" 17	12.73	12.81	11.92	14.87	14.40	12.24
" 24	16.18	14.87	18.57	18.52	14.86	17.89
Average	14.70	13.96	13.93	14.81	15.31	14.82

Table 9 showing per cents of moisture in the SUBSOIL of plots plowed on different dates. Plots 1 and 2 plowed 6 inches deep. All others 9 inches deep.

Date of Collection	Plot 1 Fall Plowed	Plot 2 Standard Plowed Apr.20	Plot 3 C Plowed Apr.14	Plot 4 C Plowed Apr.23	Plot 5 C Plowed Apr.30	Plot 6 C Plowed May 14
Apr.13			12.82			
" 20		14.12	12.64	11.68		
" 29		14.07	12.13	12.87	14.24	
May 5		13.69	13.13	12.93	14.11	
" 14		12.85	13.36	12.30	12.90	13.57
" 21	14.03	11.82	13.00	17.47	17.93	12.35
June 6	11.38	13.12	14.28	14.00	14.59	18.69
" 11	15.09	13.71	13.86	17.52	17.12	17.88
" 18	16.64	18.51	17.65	17.36	18.00	17.86
" 25	12.68	12.83	14.33	13.94	14.41	14.08
July 2	17.75	16.54	17.05	17.46	16.08	17.14
" 9	13.21	13.66	13.17	13.61	13.39	14.62
" 16	17.11	16.30	17.60	16.49	17.37	18.05
" 30	16.79	17.40	13.41	12.80	13.16	13.05
Aug. 6	13.15	12.53	11.82	16.00	16.42	13.40
" 13	18.74	17.29	14.53	13.91	14.71	15.27
" 20	11.32	10.28	11.75	16.03	13.82	11.32
" 27	14.59	11.12	13.28	14.67	13.93	14.89
Sept.3	15.53	13.19	11.13	11.64	11.41	11.23
" 10	19.73	13.33	10.92	10.65	12.07	11.43
" 17	12.09	12.69	11.70	13.13	13.98	13.91
" 24	15.09	13.38	13.55	14.97	15.39	17.06
Average	15.00	13.98	13.70	14.80	14.92	14.84

Summary. Table 10 showing an average of the per cents of moiture in the total number of plots plowed at different times and at different depths.

Number and description of plot.	Surface soil 0" to 7"	Sub-surface soil 7" to 18"	Subsoil 20" to 36"	Average moisture
Plot 1 Fall plowed About Aug.1 6"	18.18	14.70	15.00	15.96
Plot 2 Standard Plowed Apr.20 6"	15.07	13.96	13.98	14.33
Plot 3 A Plowed Apr.14 3"	15.16	14.16	13.94	14.42
Plot 3 B Plowed Apr.14 6"	15.72	14.36	14.24	14.77
Plot 3 C Plowed Apr.14 9"	16.01	13.93	13.70	14.54
Plot 4 A Plowed Apr.23 3"	15.71	14.21	14.01	14.64
Plot 4 B Plowed Apr.23 6"	16.32	15.34	14.86	15.49
Plot 4 C Plowed Apr. 23 9"	16.68	14.81	14.80	15.43
Plot 5 A Plowed Apr.30 3"	16.45	15.09	14.62	15.38
Plot 5 B Plowed Apr.30 6"	15.79	15.00	14.58	15.12
Plot 5 C Plowed Apr.30 6"	16.36	15.31	14.92	15.53
Plot 6 A Plowed May 14 3"	15.97	14.81	14.88	15.22
Plot 6 B Plowed May 14 6"	15.12	15.22	14.97	15.10
Plot 6 C Plowed May 14 9"	15.24	14.82	14.84	14.96

Note. In securing all the averages no account was taken of the samples secured from any plot prior to May 21 since by excluding these all the averages are comparable with the fall plowed plot.

Table 11 showing per cents of moisture in the SURFACE soil of oat plots. Plots both drilled and broadcasted, with and without clover.

Date of Collection	Plot 7 Broad cast	Plot 8 drilled	Plot 9 drilled clover	Plot 10 broadcast clover
Apr. 23	11.87	13.95	14.47	13.50
" 30	14.42	15.70	14.67	14.59
May 7	13.62	14.26	14.45	14.03
" 14	13.78	13.52	14.25	14.53
" 21	12.98	14.19	13.57	12.45
June 6	14.59	14.35	13.82	13.94
" 11	13.25	14.85	9.92	8.91
" 18	12.21	12.72	12.32	11.92
" 25	9.28	11.02	10.68	10.62
July 2	10.32	11.04	10.88	10.45
" 9	13.55	13.06	12.37	10.72
" 16	13.17	14.12	13.12	14.44
" 30	10.27	10.81	12.62	12.40
Average	12.56	13.35	12.85	12.50

Table 12 showing per cents of moisture in the SUB-SURFACE soil of oat plots. Plots both drilled and broadcasted, with and without clover.

Date of Collection	Plot 7 Broad cast	Plot 8 drilled	Plot 9 drilled clover	Plot 10 broadcast clover
Apr. 23	14.04	13.50	13.83	13.09
" 30	13.83	14.56	14.15	13.41
May 7	15.33	14.08	14.49	14.82
" 14	14.83	14.22	13.49	11.10
" 21	#	14.63	13.77	14.64
June 6	17.07	16.77	16.16	16.08
" 11	15.14	15.53	11.20	10.87
" 18	16.08	14.93	14.56	14.15
" 25	11.17	10.88	13.63	12.97
July 2	13.01	13.98	13.10	13.25
" 9	11.96	13.63	10.80	11.44
" 16	13.05	13.56	14.31	15.26
" 30	10.68	11.03	12.46	13.41
Average	13.84	13.94	13.68	13.42

sample accidentally spoiled.

Table 13 showing per cents of moisture in the SUBSOIL of oat plots. Plots both drilled and broadcasted, with and without clover.

Date of Collection	Plot 7 Broad cast	Plot 8 drilled	Plot 9 drilled clover	Plot 10 broadcast clover
Apr. 23	13.03	13.04	13.32	12.98
" 30	#	13.46	13.04	12.76
May 7	13.30	13.28	14.39	13.64
" 14	13.23	13.06	12.83	11.18
" 21	13.57	13.19	13.29	13.27
June 6	16.76	17.07	13.07	16.59
" 11	17.54	17.11	12.87	12.53
" 18	17.37	14.89	15.46	15.88
" 25	12.79	11.46	13.10	16.22
July 2	13.45	14.03	13.69	13.43
" 9	12.06	10.55	11.96	11.22
" 16	13.34	14.37	13.48	13.55
" 30	11.42	11.93	13.00	12.74
Average	13.98	13.64	13.34	13.53

Sample accidentally spoiled.

Summary:- Table 14 showing an average of the per cents of moisture in all the oat plots, both drilled and broadcast, with and without clover.

Number of plot	Surface soil 0" to 7"	Sub-surface soil 7" to 18"	Subsoil 20" to 36"	Average moisture
Plot 7 Broadcast without clover	12.56	13.84	13.98	13.46
Plot 8 Drilled without clover	13.35	13.94	13.64	13.64
Plot 9 Drilled with clover	12.85	13.68	13.34	13.29
Plot 10 Broadcast with clover	12.50	13.42	13.52	13.15

Table 15 showing per cent of moisture in SURFACE soil of plots cultivated at different intervals. All cultivated 3 inches deep.

Date of Collection	Plot 11 A Cultivated every 5 days	Plot 12 A Cultivated every 10 days	Plot 13 A Cultivated twice	Plot 14 A Standard 3 cultivations
May 21	14.00	14.99	15.00	16.21
June 6	18.50	18.30	18.34	17.95
" 11	13.30	14.02	13.59	15.51
" 18	18.96	19.35	18.63	16.06
" 25	18.25	16.79	18.02	16.69
July 2	13.43	12.01	11.69	12.03
" 9	15.56	17.39	19.80	20.97
" 16	15.84	17.11	16.62	16.93
" 30	15.38	12.97	10.57	11.41
Aug. 6	10.54	11.50	13.86	14.02
" 13	12.73	10.41	10.02	10.02
" 20	13.07	12.50	13.81	12.27
" 27	17.09	18.00	18.80	17.13
Sept. 3	14.47	15.15	13.12	15.99
" 10	15.02	16.04	13.28	11.98
" 17	14.56	14.96	17.17	12.59
" 24	18.62	14.15	21.51	12.59
Average	15.25	15.03	15.52	15.23

Table 16 showing per cents of moisture in SUB-SURFACE soil of plots cultivated at different intervals. All cultivated 3 inches deep.

Date of Collection	Plot 11 A Cultivated every 5 days	Plot 12 A Cultivated every 10 days	Plot 13 A Cultivated twice	Plot 14 A Standard 3 cultivations
May 21	13.27	13.64	13.89	18.69
June 6	18.36	16.91	17.49	19.64
" 11	13.68	14.41	14.69	14.85
" 18	16.99	18.70	17.45	13.27
" 25	18.60	19.59	19.21	17.73
July 2	17.09	14.21	14.23	13.82
" 9	14.41	14.48	19.97	18.47
" 16	17.61	15.90	18.72	16.53
" 30	16.64	14.20	10.87	10.89
Aug. 6	11.36	11.72	14.81	14.89
" 13	13.80	10.37	10.80	10.49
" 20	11.03	10.48	11.14	10.99
" 27	12.81	13.57	14.78	13.47
Sept. 3	11.18	12.76	13.22	15.22
" 10	11.84	14.20	14.51	10.02
" 17	15.14	13.27	15.75	11.56
" 24	17.62	13.67	20.43	20.02
Average	14.79	14.24	15.40	14.73

Table 17 showing per cents of moisture in SUBSOIL of plots cultivated at different intervals. All cultivated 3 inches deep.

Date of Collection	Plot 11 A Cultivated every 5 days	Plot 12 A Cultivated every 10 days	Plot 13 A Cultivated twice	Plot 14 A Standard 3 cultivations
May 21	13.74	14.36	12.77	17.18
June 6	18.45	18.19	17.41	17.95
" 11	13.58	13.83	13.40	13.52
" 18	18.62	17.22	16.63	12.57
" 25	17.73	17.37	17.15	17.05
July 2	16.26	14.67	13.80	14.25
" 9	14.53	12.74	17.52	18.30
" 16	17.62	17.35	17.88	17.66
" 30	17.19	15.64	11.25	12.16
Aug. 6	11.59	12.96	16.07	14.03
" 13	13.26	11.22	10.48	12.10
" 20	10.49	10.27	11.05	10.63
" 27	13.04	12.78	14.60	14.09
Sept. 3	12.45	11.89	12.47	14.60
" 10	10.18	12.45	13.22	10.68
" 17	14.32	12.81	13.64	11.26
" 24	14.55	14.67	15.87	18.69
Average	14.56	14.14	14.42	15.10

Table 18 showing per cents of moisture in SURFACE soil of plots cultivated at different intervals. All cultivated 6 inches deep.

Date of Collection	Plot 11 B Cultivated every 5 days	Plot 12 B Cultivated every 10 days	Plot 13 B Cultivated twice	Plot 14 B Standard 3 cultivations
May 21	16.27	13.63	14.22	13.90
June 6	18.33	17.47	16.38	17.10
" 11	15.79	15.23	15.30	14.28
" 18	19.11	17.56	13.99	15.39
" 25	17.02	17.43	16.86	14.74
July 2	16.04	12.52	12.31	12.33
" 9	14.95	12.88	19.83	20.21
" 16	16.89	15.73	15.07	17.48
" 30	12.82	10.66	10.60	11.95
Aug. 6	10.36	13.43	13.79	13.88
" 13	11.93	10.56	10.41	9.22
" 20	13.55	12.71	15.64	13.88
" 27	18.65	18.28	18.29	17.79
Sept. 3	14.20	14.56	16.55	15.97
" 10	13.34	14.93	16.25	13.70
" 17	14.39	17.37	17.50	12.64
" 24	14.76	20.01	20.63	18.06
Average	15.20	14.99	15.50	14.85

Table 19 showing per cents of moisture in SUB-SURFACE soil of plots cultivated at different intervals. All cultivated 6 inches deep.

Date of Collection	Plot 11 B Cultivated every 5 days	Plot 12 B Cultivated every 10 days	Plot 13 B Cultivated twice	Plot 14 B Standard 3 cultivations
May 21	14.67	13.63	14.90	12.78
June 6	18.42	18.74	16.73	18.68
" 11	13.20	14.63	14.25	#
" 18	17.92	17.73	15.11	14.73
" 25	16.85	18.18	18.35	17.18
July 2	16.38	14.37	13.81	13.81
" 9	13.33	14.15	19.82	18.69
" 16	16.85	17.07	17.48	18.70
" 30	12.84	10.93	11.54	12.51
Aug. 6	11.81	14.31	14.05	14.22
" 13	12.91	11.71	10.92	10.73
" 20	10.30	10.36	12.32	10.81
" 27	17.57	13.32	13.43	14.60
Sept. 3	10.68	11.65	12.92	13.66
" 10	12.39	16.13	12.58	11.74
" 17	13.08	15.03	14.60	12.47
" 24	13.81	15.49	16.89	14.55
Average	14.30	14.55	14.68	14.36

Sample accidentally spoiled.

Table 20 showing per cents of moisture in SUBSOIL of plots cultivated at different intervals. All cultivated 6 inches deep.

Date of Collection	Plot 11 B Cultivated every 5 days	Plot 12 B Cultivated every 10 days	Plot 13 B Cultivated twice	Plot 14 B Standard 3 cultivations
May 21	13.25	13.35	14.14	12.66
June 6	17.70	17.99	17.51	18.85
" 11	13.85	13.17	13.29	#
" 18	16.94	18.27	13.12	13.84
" 25	16.61	16.76	16.66	16.77
July 2	15.17	13.57	14.25	13.96
" 9	13.50	13.37	17.90	17.16
" 16	16.65	16.93	17.00	17.19
" 30	14.22	12.45	11.61	12.23
Aug. 6	14.39	13.21	13.27	14.38
" 13	11.72	12.01	10.96	11.03
" 20	11.91	10.15	10.63	10.36
" 27	15.22	14.71	14.33	13.60
Sept. 3	10.65	11.08	14.74	15.36
" 10	12.37	13.29	10.87	11.43
" 17	12.79	15.94	11.02	13.46
" 24	13.30	10.40	14.59	14.22
Average	14.13	13.92	13.87	14.15

Sample accidentally spoiled.

Summary:- Table 21 showing an average of the per cents of moisture in the total number of plots cultivated at different depths and with varying frequency.

Number and description of plot.	Surface soil 0" to 7"	Sub-surface soil 7" to 18"	Subsoil 20" to 36"	Average moisture
Plot 11 A 3" Cultivated every 5 days	15.25	14.79	14.56	14.86
Plot 11 B 6" Cultivated every 5 days	15.20	14.30	14.13	14.54
Plot 12 A 3" Cultivated every 10 days	15.03	14.24	14.14	14.47
Plot 12 B 6" Cultivated every 10 days	14.99	14.55	13.92	14.48
Plot 13 A 3" Cultivated twice	15.52	15.40	14.42	15.11
Plot 13 B 6" Cultivated twice	15.50	14.68	13.87	14.68
Plot 14 A 3" Standard plot	15.23	14.73	15.10	15.02
Plot 14 B 6" Standard plot	14.85	14.36	14.15	14.45

Table 22. Meterological Summary, by weeks, from the time plot 1 was plowed, Aug.1, 1903, until the last collection of samples was made, Sept. 24, 1904.

1903--1904	Temperatures Max.	Min.	Rainfall inches	clear days	cloudy days	partly cloudy
Aug. 1 to 7	78.5	61.2	.43	1	2	4
7 to 14	78.5	56.7	.38	0	1	6
14 to 21	83.1	58.4	.27	1	1	5
21 to 28	88.8	68.1	1.25	1	1	5
28 to Sept. 5	77.1	54.5	.00	1	1	5
5 to 12	82.2	58.5	.09	0	0	7
12 to 19	77.1	57.0	.41	1	1	5
19 to 26	78.5	43.7	.00	6	0	1
26 to Oct. 3	75.4	50.5	.49	2	2	3
3 to 10	73.1	51.4	2.49	1	1	5
10 to 17	72.0	37.0	.13	4	0	3
17 to 24	73.0	30.0	.00	5	0	2
24 to 31	69.0	21.0	.00	5	0	2
31 to Nov. 7	71.0	26.0	.84	1	1	5
7 to 14	63.0	21.0	.34	3	0	4
14 to 21	62.0	11.0	.88	2	1	4
21 to 28	49.0	8.0	.00	3	0	4
28 to Dec. 5	29.0	14.0	.00	1	3	3
5 to 12	38.0	5.0	.02	2	2	3
12 to 19	45.0	-7.0	1.47	4	0	3
19 to 26	43.0	1.0	.67	2	1	4
26 to Jan. 2	41.0	0.0	.04	1	2	4
2 to 9	38.0	-14.0	.30	2	0	5
9 to 16	35.0	-2.0	.26	0	3	4

Meterological table continued.

1903--1904	Temperatures Max.	Min.	Rainfall inches	clear days	cloudy days	partly cloudy
16 to 23	50.0	11.0	1.77	1	3	3
23 to 30	25.0	-15.0	.67	1	1	5
30 to Feb. 6	44.0	-11.0	.09	1	0	6
6 to 13	60.0	4.0	.20	1	2	4
13 to 20	40.0	-5.0	.66	2	3	2
20 to 27	45.0	4.0	.57	1	4	2
27 to Mar. 5	58.0	18.0	.42	2	1	4
5 to 12	55.0	28.0	.58	2	3	2
12 to 19	41.0	11.0	1.68	0	5	2
19 to 26	71.0	29.0	4.47	1	2	4
26 to Apr. 2	72.0	21.0	1.46	0	0	7
2 to 9	69.0	25.0	.89	2	2	3
9 to 16	62.0	26.0	.00	1	1	5
16 to 23	65.0	22.0	.18	3	0	4
23 to 30	80.0	34.0	2.37	1	1	5
30 to May 7	77.0	42.0	.08	3	0	4
7 to 14	79.0	41.0	.55	2	0	5
14 to 21	81.0	38.0	.28	2	1	4
21 to 28	87.0	48.0	.32	3	0	4
28 to June 4	88.0	40.0	.54	2	1	4
4 to 11	80.0	50.0	.10	4	0	3
11 to 18	88.0	50.0	.55	4	0	3
18 to 25	85.0	55.0	.11	0	0	7
25 to July 2	87.0	54.0	.21	0	0	7
2 to 9	86.0	41.0	2.02	0	1	6
9 to 16	87.0	61.0	.32	3	0	4

Meterological table continued.

1903--1904	Temperatures Max.	Min.	Rainfall inches	clear days	cloudy days	partly cloudy
16 to 23	92.0	60.0	.00	5	0	2
23 to 30	85.0	51.0	.28	3	0	4
30 to Aug. 6	90.0	56.0	.00	2	0	5
6 to 13	89.0	47.0	.50	4	0	3
13 to 20	90.0	53.0	1.31	3	1	3
20 to 27	91.0	47.0	1.44	4	0	3
27 to Sept. 3	87.0	46.0	.30	2	1	4
3 to 10	83.0	49.0	.00	4	0	3
10 to 17	87.0	41.0	.66	3	0	4
17 to 24	85.0	44.0	1.36	3	0	4
24 to Oct. 1	89.0	59.0	.51	2	0	5

Monthly Summary.

1903						
Aug.	94	52	2.33	1	6	24
Sept.	90	35	.99	10	1	19
Oct.	87.5	21	2.70	15	2	14
Nov.	68	8	2.06	8	5	17
Dec.	45	-7	2.18	5	4	22
Jan.1904	50	-15	3.09	4	9	18
Feb.	60	-11	1.86	3	6	20
March	72	11	7.66	5	8	18
April	80	22	3.97	8	4	18
May	87	41	1.60	10	2	19
June	88	40	1.17	9	0	21
July	92	41	1.72	11	2	18
Aug.	91	46	3.55	13	2	16
Sept.	89	41	2.53	12	2	16

Observations and notes taken during the season.

Oat Plots.

The first differences noticed on any of the plots was seen on June 9, on the oat plots. At this date it was apparent that the plots upon which the oats had been drilled (plots 8 and 9) were in advance of the plots where the oats were sown broadcast (plot 7 and 10). Not only were the oats taller on the drilled plots but the blades were broader, the plants had stooled more, and the color was darker green than on the plots of broadcasted oats. Observations taken on June 18 and on June 25 showed that the lead gained at the beginning of the season was enough to keep the drilled plots ahead of the others. On June 25 none of the plots of oats showed any heads although the drilled plots showed that they would head before those broadcasted. On June 27 one half of all the oats on the drilled plots were headed while there were scarcely any heads out on the broadcasted plots. On July 1 the drilled oats were completely headed out even to the smaller, shorter stalks, while an examination of those plots which were broadcasted showed that barely half the stalks were headed. The plots were examined every day between the first and seventh of July and only on the latter date were the oats on the broadcasted plots found to be completely headed out. The height of several hundred stalks in each plot was measured on July 9 and the average height of the broadcasted oats was 33 inches while the average height of the drilled oats was 37 inches. The drilled oats were much more uniform in height than those broadcasted and the stalks were larger, with more foilage, and appeared more sturdy. All the oat plots were harvested on July 26. At this time the drilled oats were in prime condition to harvest while the broadcast oats were

still somewhat green. The green heads of the broadcasted oats were those that were short and more or less shaded by the taller stalks. On harvesting it was found that the broadcasted oats were quite rusty while the drilled oats were affected scarcely at all. An examination of the clover which was sown in with the oats on plots 9 and 10 showed about the same amount dead, and an equally good stand on the broadcasted as on the drilled plot. The average per cent of moisture of the oat plots during the season as shown in table number 14 and the yield per acre of both grain and straw from the different plots as shown in table number 23, is here shown again.

Plot Number and Description.	Average per cent of Moisture during the Season	Yield per acre Bushels of grain.	Yield per acre Tons of Straw
Plot 7. Oats broadcasted without clover.	13.46	34.6	.80
Plot 8. Oats drilled without clover	13.64	53.4	.80
Plot 9.Oats drilled with clover.	13.29	45.0	.86
Plot 10.Oats broadcasted with clover.	13.15	37.5	.65

The effect of the drilling, whether clover was seeded with the oats or not, is very apparent both in the slight increase in the moisture content and in the marked increase in the yield of grain per acre. In as much as large yields of grain necessitated a greater supply of moisture it is apparent that the influence of drilling is much greater than indicated by the per cents of moisture of the different plots.

Corn Plots.

There was very little difference noticeable in the corn on the plots of spring plowing prior to July 7, although the corn on the fall plowed plot was markedly better and more forward from its first appearance above the ground. The corn, on all the plots previous to the putting forth of the ear shoots, seemed to make its most rapid growth, appeared most vigorous, was the best color, and indicated most clearly that it was securing a sufficient supply of food and moisture, from July 2 to 16. The few days when growth was most rapid were from July 4 to July 9. An examination of the meterological table which is included on page 33 will show that the days when growth was most vigorous corresponds quite closely with a large amount of rain fall and the period when the corn was suffering most corresponds in like measure to a deficiency of rainfall.

On July 7 a number of measurements of the height of the corn was taken and the average height of the corn on the spring plowed plots was 37 inches. The average height of the corn on the fall plowed plot, however, was 45 inches. At this date too the corn on the first two plots of spring plowing which were plowed three inches deep, (Plots 3 A and 4 A) was more vigorous appearing and a little taller than that on plots 3 B and 4 B or 3 C and 4 C which were plowed 6 and 9 inches deep respectively. On those plots which were plowed later in the season, however, (Plots 3 A,B, & C and 6 A, B, & C) the corn showed the greatest thrift and vigor on those plowed six and nine inches deep. No further striking differences were noticed in the experiment of depth and the time of plowing until July 26. On this date the corn was tasseling and silking rapidly and the order of plots in which the tassels and silks were most forward was exactly

reversed from that of July 7. In other words, on the plots plowed early in the season the deep plowed plots (3 C and 4 C) were farthest advanced, while on the later plowed plots the shallow plowing (5 A and 6 A) was most forward.

From July 20 to August 20 the corn on all the plots, except plot 1, fall plowed plot, gave evidence of distress and injury by wilting, rolling of the leaves during the day, and finally by the firing of the bottom leaves. (See Table No.22). It was very apparent that the corn on the fall plowed plot could obtain, either a sufficient amount of moisture to keep the plants from wilting, or else a sufficient amount of food to enable them to withstand the heat more successfully during this hot, dry, period than the other, or spring plowed plots. On August 16 the corn seemed to have finished putting forth ear shoots and so a count of the per cent of stalks bearing an ear shoot, of any promise whatever, was made. Some observations and notes were also taken at this time in regard to the firing of the lower leaves. The plots showed the effects of the drought as follows:-

Plot 1, fall plowed plot, was found to have suffered but little. The lowest leaf of the stalks only having fired. This was not invariably found on all the hills, for some showed not the slightest effects from the dry weather. Actual count showed that 96% of all the stalks of the plot had an ear of good size and promise set on them. The corn on plot 2 gave evidence of having suffered more than the corn of any other plot since the lower leaves were all dead and dry for at least half the distance to the ears. The stalks averaged six dried leaves, and some of them had tassels burned as well. A count showed that 81% of the stalks gave promise of

producing an ear. Plots 3 A, 3 inch plowing, 3 B, 6 inch plowing, and 3 C 9 inch plowing showed the effects of the drought in exactly the order in which they were plowed. 3 A was fired the most, 3 B a little less and 3 C the least of this series which was plowed on April 14. Plot 3 A had 90%, 3 B had 88%, and 3 C had 85% of the stalks bearing promising ear shoots. The plots plowed on April 23 (4 A, 3 inches, B,6 inches, and C,9 inches) show the effect of dry weather in exactly the same way as the preceding series. The per cent of stalks bearing ear shoots, however, varies considerably. Plot 4 A had 92%, 4 B had 85% and 4 C had 89% of bearing stalks. On examining the series plowed April 30 it was found that there was considerable difference shown between the corn on the different depths of plowing. Plot 5 B plowed April 30, 6 inches deep showed that it had suffered less than either 5 A plowed 3 inches or 5 C plowed 9 inches for on plot 5 B the stalks were larger, greener, and stood up better than on the other plots. A larger per cent of the stalks of this plot bore ear shoots also, for a count showed 5 A to have 75% of the stalks bearing an ear while 5 B had 88% and 5C had 84%.

The next series, representing the latest plowing of the season, May 14, showed the same variations as plots 5 A, B and C did, the only difference being, that the corn was fallen or blown down much worse than on any of the other plots, and that there was a smaller per cent of barren stalks than on the preceding series. A count gave 6 A 88%, 6 B 89% and 6 C 87% of the stalks bearing an ear. The fallen condition of the corn on this last series is due perhaps more to its being the most southern series and thus received the unbroken force of the winds from the southwest. This explanation seems quite plausible since 6 C, the Southermost plot of the series. was

fallen the worst of any and this condition was also true for plot 14 B which was the outside plot to the south in the cultivation experiment.

Corn Plots.

Depth and frequency of Cultivation.

On July 7 and on July 26 there were no noticeable differences among the plots in the cultivation experiment. At the last cultivation of the plots 13 A and B(cultivated on June 14 and July 14) it was markedly apparent that the cultivator was tearing and breaking a great many more roots than on those plots which had received more frequent cultivation. This breaking of the roots was noticed most on plot 13 B (6 inch cultivation) although many roots were broken by the shallower cultivation. This disturbance of the roots appeared to influence the total growth in height of the stalks for observations taken on August 16 showed that the corn on 13 A and 13 B cultivated but twice during the season averaged ten inches shorter than on the other plots. It is possible, however, that the disturbance of the roots in cultivation does not wholly account for the difference in height of these plots when compared with the others, and with the standard plot in particular, for the stirring of the soil a greater number of times may have induced a liberation of plant food on the other plots or the undisturbed condition of the soil may have induced superficial root growth and provided less soil from which to draw a supply of food. The growth of the stalks, other than height, however, was equal to those on the other plots. The only difference in the growth or appearance betweenA cultivated 3 inches deep and B cultivated 6 inches deep of any of the plots was in height, for B in every case was shorter stalked than A. Any difference in the thrift of the

corn, which was cultivated with more or less frequency, was not perceptible.

A count made August 16 showed Plot 11 A cultivated every 5 days to have 5% of barren stalks; 11 B 6%. 12 A cultivated every 10 days had 6% and 12 B 7%. 13 A cultivated but twice during the season had 6% and 13 B 7%, while 14 A cultivated three times had but 4% and 14 B but 5% of the stalks not bearing ears.

Conclusion.

At the outset I would say that the amount of data collected as yet, is too small and the length of time the experiment has run is too short, to draw any definite conclusions, since one year is not sufficient to prove anything definite concerning the moisture content of the soil. The season of 1904 was peculiar in many respects, (See meterological table) and it will necessitate the continuance of such work as this for a series of years in order to secure a sufficient range of difference to warrant definite statements concerning the effect of the time and depth of plowing and of cultivation on the moisture content of soils.

There may be certain tendencies, however, sufficiently prominent in the work already done, to be worthy of notice.

Judging from one seasons work, fall plowing retains more moisture than spring plowing; and deficiency of rainfall, because of this retention of moisture, effects corn less when planted on fall plowed land. An examination of the following table will indicate how great an effect the increased moisture content had on the yield per acre, although the table shows but a slight increase in the average moisture content for the season, over the other plots.

Table 23 showing the yields of grain and stover from the various plots plowed at different depths and at different times, together with the average moisture content of the plot during the entire season.

Number of Plot and treatment	Average moisture content	Bushels of corn per acre	Tons of stover per acre
1 Fall Plowed	15.96	81.8	2.3
2 Plowed 6 inches deep April 20	14.54	49.2	1.3
3 A Plowed 3 inches deep April 14	14.39	61.1	1.4
3 B Plowed 6 inches deep April 14	14.82	44.5	1.3
3 C Plowed 9 inches deep April 14	14.67	42.8	1.3
4 A Plowed 3 inches deep April 23	14.51	49.5	1.2
4 B Plowed 6 inches deep April 23	15.25	44.8	1.2
4 C Plowed 9 inches deep April 23	15.17	39.6	1.3
5 A Plowed 3 inches deep April 30	15.39	39.8	1.3
5 B Plowed 6 inches deep April 30	15.11	40.2	1.3
5 C Plowed 9 inches deep April 30	15.37	39.7	1.3
6 A Plowed 3 inches deep May 14	14.98	41.8	1.3
6 B Plowed 6 inches deep May 14	15.03	44.7	1.3
6 C Plowed 9 inches deep May 14	14.92	40.6	1.5

We also find that the fluctuations of moisture are more gradual and less extensive on fall plowed than on spring plowed land. The much larger per cent of moisture in the surface soil of Plot 1 when compared with any of the other plots is also worthy of notice. (Table 10)

This observation is substantiated by experiments at the Wisconsin Agricultural Experiment Station, for in the Seventh Annual Report from that Station they say "Fall plowing tends to draw water to the surface, with minerals held in solution, thus concentrating fertility at the surface and preventing loss by under drainage."

When we take into account the ease with which fall plowing can be worked, the increased amount of moisture retained, the excess of grain produced and the uniformity of moisture content throughout the season we are almost led to say that this method of preparation for corn ground is unexcelled. Observations taken from a series of years however, would be necessary to prove this theory and at the end of such a series of years some factor, such as leaching of the soil, more than counterbalance the gain.

It is quite evident that a total moisture content below 13% is injurious to corn. An examination of table No.22 shows that when the corn suffered the most the total moisture content of the soil, especially of the surface and sub-surface, was below the per cent given.

It was also very apparent, from the same table, that a total moisture content of 15% or above, is sufficient to supply the corn plant with an amount of moisture that will enable it to make a rapid, vigorous, healthy growth.

Table No.24.

No.of Plot	% of moisture when corn was doing its best.			% of moisture when corn was suffering		
	Surface	Sub-surface	Subsoil	Surface	Sub-surface	Subsoil
Plot 1 Fall plowed	19.21	16.05	16.02	15.28	13.07	15.00
Plot 2 6" Standard	15.99	15.38	15.50	11.62	12.89	14.35
Plot 3 A 3" April 14	18.31	17.30	16.16	12.84	12.65	13.60
Plot 3 B 6" April 14	16.89	16.79	15.82	12.25	11.30	13.70
Plot 3 C 9" April 14	18.64	16.62	15.94	12.76	11.53	12.88
Plot 4 A 3" April 23	17.57	15.85	16.04	12.60	11.77	12.25
Plot 4 B 6" April 23	16.44	16.64	16.02	13.78	12.97	14.04
Plot 4 C 9" April 23	19.00	17.05	15.85	13.97	13.19	14.68
Plot 5 A 3" April 30	17.83	16.71	15.91	12.61	13.51	13.60
Plot 5 B 6" April 30	17.36	16.96	16.33	12.99	13.61	14.03
Plot 5 C 9" April 30	17.66	17.19	15.61	13.38	13.56	14.52
Plot 6 A 3" May 14	17.89	16.75	16.21	13.01	12.95	13.93
Plot 6 B 6" May 14	15.58	16.76	13.80	12.72	12.90	14.62
Plot 6 C 9" May 14	17.15	16.39	16.60	11.69	12.20	13.26

Table No.24 (second part) strongly indicates that no matter whether land is plowed early in the season or quite late, a six inch plowing is more retentive of moisture than either a shallower or deeper.

Table No. (Second part) showing the differences between the moisture content of the surface, sub-surface and subsoil of the various plots, when the corn was making its most vigorous growth and when it was suffering most.

No.of Plot.	Surface	Sub-surface	Subsoil
Plot 1 Fall plowed	3.93%	2.98%	1.02%
" 2 Plowed 6" April 20	4.37	2.49	1.15
Plot 3 A Plowed 3" April 14	5.47	4.65	2.56
Plot 3 B Plowed 6" April 14	4.64	5.49	2.12
Plot 3 C Plowed 9" April 14	5.88	5.09	3.06
Plot 4 A Plowed 3" April 23	4.97	4.08	3.79
Plot 4 B Plowed 6" April 23	2.66	3.67	1.98
Plot 4 C Plowed 9" April 23	5.03	3.86	1.17
Plot 5 A Plowed 3" April 30	5.22	3.20	2.31
Plot 5 B Plowed 6" April 30	4.37	3.35	2.30
Plot 5 C Plowed 9" April 30	4.28	3.63	1.09
Plot 6 A Plowed 3" May 14	4.88	3.80	2.28
Plot 6 B Plowed 6" May 14	2.86	3.86	-.82
Plot 6 C Plowed 9" May 14	5.46	4.19	3.34

The yields per acre however, (table No.23) show that when land is plowed early in the season the shallower, or three inch plowing, gives the best results, while such land as is broken after April should be plowed six inches deep.

From the Seventh Annual Report of the Wisconsin Station we secure substantiation to this conclusion since at that station it was found that "Shallow plowing diminishes surface evaporation, and allows capillary action to lift water from below to the roots of the plants."

In no case was the nine inch plowing beneficial. The saving of labor for both man and team in plowing no deeper than six inches would necessitate a considerable increase of crop to warrant the practice. Since deep plowing at any season, fails to augment the moisture holding capacity of the soil, does not increase the yield of grain, and necessitates considerably more labor, there is no use in practicing it.

From the Wisconsin Report already referred to we get the following, "Deep plowing in the spring tends to produce a deficiency of moisture." In the case of plots plowed 9 inches deep, however, it is hardly just to attribute the poor quality and small quantity of corn harvested to the insufficiency of moisture alone. This season was the first season these plots had been plowed to this depth and there was at least two inches of new soil thrown on top which perhaps needed the action of weather upon it to render it in shape to be comparable with the soil of the other plots. At any rate these deep plowed plots presented a different appearance in the soil throughout the whole season.

In the oats experiment it is clearly indicated that the

moisture content is greater where the oats are drilled than where they are broadcasted. This is only true in the surface and sub-surface soil however, for the moisture content of the subsoil was greater in the broadcasted plots. The sowing of clover in the oats helps to decrease the moisture content but not nearly so much as is generally supposed. The stand of clover on the plot of broadcasted oats was so much poorer than on the drilled plot that the figures shown can hardly be taken as representative of its effects. When we consider the yield of oats and the influence of the clover on the yield the effect is more clearly indicated.

The figures representing the yields as indicated in the following table show considerable increase from the drilled plots. The moisture content is some greater on the plots where the oats were drilled but when we consider the fact that large yields require more moisture than small ones we can readily see how much greater the moisture content of the drilled plots must have been.

Table giving the yield of oats and straw from the various plots both drilled and broadcast, with and without clover, together with the average moisture content of each plot during the entire season.

Number of plot	Average moisture content	Bushels of Oats per acre	Tons of straw per acre
Plot 7 Oats broadcast	13.46	34.6	.80
Plot 8 Oats drilled	13.64	53.4	.80
Plot 9 Oats drilled with clover	13.29	45.0	.86
Plot 10 Oats broadcast with clover	13.15	37.5	.65

With the cultivation experiments the results show very little indication of the superiority of one system of cultivation over another. The amounts of moisture in the soil of the different plots varies quite uniformly and nothing marked or unusual is shown. If any plots have a sufficient amount of moisture above the others to be worthy of notice they are those which were cultivated but twice during the season. (Plots 13 A and B) These contain the greatest amount of moisture but they failed to give a yield sufficiently large to warrant cultivation in this way. It is very evident when yield is considered that something besides moisture must be furnished the plant before it will do its best.

The plots cultivated every ten days (12 A and B) held nearly as much moisture as the preceding plots and the yield of grain was considerably greater; being 78.2 bushel from 12 A in comparison with 70.7 bushel from 13 A and 73 bushel from 12 B in comparison with 68.3 bushel from 13 B. These plots too 12 A and 12 B were the ones that gave the greatest difference between the deep and shallow cultivation and here we find a decided yield in favor of the shallow culture.

Comparing all the plots with the standard plot we find them all, except 13 A and B cultivated but twice during the season, lower in moisture content than the standard plots and all, with the same exception, produced a less yield per acre than the standard. Plots 11 A and B cultivated every five days during the season, seem to indicate clearly that too much work can be put on corn, and that the moisture content of the soil and the yield per acre can be reduced thereby.

Table showing yield of grain and stover from the various plots cultivated at different depths and frequency, together with the average moisture content of each plot during the entire season.

Number of Plot	Average moisture content	Bushels of corn per acre	Tons of stover per acre
11 A 3" Every 5 days	14.86	64.1	1.5
11 B 6" Every 5 days	14.54	68.6	1.5
12 A 3" Every 10 days	14.47	78.2	1.7
12 B 6" Every 10 days	14.77	73.0	1.7
13 A 3" Twice	15.11	70.7	1.9
13 B 6" Twice	14.68	68.3	1.8
14 A 3" Standard 3 times	15.02	73.9	1.8
14 B 6" Standard 3 times	14.45	74.1	1.9

In general it is regarded that shallow culture is much better than deep but of fifty one experiments reported from different parts of the United States only 65% of them were directly in favor of shallow cultivation, and of this 65%, none of them were decided in regard to the conservation or retention of soil moisture. The 1894 report of the Wisconsin State Board of Agriculture seems to sum the whole matter up quite conclusively when it says "It seems clear that tha best depth to cultivate is not constant, either for the soil or the seasons."

As stated at the outset, this seasons work was not as satisfactory as was anticipated when begun, for it was hoped that some definite data could be secured which would assist along at least two lines of work in Agronomy. We appreciate more fully the necessity of continued study along any one line of work since this meagre accumulation of information has only shown that it is but by continued investigation that anything useful is acquired. If it were possible I would like to assist in the securing of definite data and in the compilation of such information into readable shape for the general public. If, however, any data I have secured will be of service to others investigating along this line I shall feel amply rewarded.

A Bibliography of the available American literature which bears most directly on the subject of Soil Moisture.

(1) Seventh Annual Report of the Wisconsin Agricultural Experiment Station.

A discussion of results of deep and shallow spring plowing, of fall plowing, and of various other phases of soil moisture problems. (Excellent)

(2) Second Annual Report of the Michigan Agricultural Experiment Station.

Relation of Cultivation to Soil Moisture.

(3) Second Annual Report of the South Carolina Agricultural Experiment Station.

Determination of Soil Moisture and the effect of cultivation upon the same.

(4) Annual Report of the Maryland Agricultural Experiment Station for 1891.

The Improvement of Soil and Increase of its Water-holding Capacity.

(5) Annual Report of the Wisconsin Agricultural Experiment Station for 1891.

Investigations relating to Soil Moisture.

This includes the influence of spring plowing, early cultivation, manuring, etc. (Excellent)

(6) Annual Report of the Wisconsin Agricultural Experiment Station for 1892.

Effect of deep and shallow cultivation on the moisture content of the soil and on the crops grown.

(7) Annual Report of the Minnesota Agricultural Experiment Station for 1893.

The Conservation of Soil Moisture.

(8) Kansas Agricultural College--The Industrialist No.8 1895.

Soil Moisture and Fall Plowing.

(9) New York Agricultural Experiment Station (Cornell) Bulletin No.120

The Moisture of the Soil and its Conservation.

(10) Iowa Agricultural Experiment Station Bulletin No.32.

Samples taken from plots of corn, clover, oats, beets and blue-grass and per centage of moisture determined. Also the cultivation of corn three inches deep compared with cultivation of less depth.

(11) Annual Report of the Wisconsin Agricultural Experiment Station 1894.

The effect of depth of cultivation on the water content of soils.

(12) Annual Report of the North Dakota Agricultural Experiment Station for 1896.

Soil Moisture Studies--Moisture as affected by cultivation.

(13) Annual Report of the Wisconsin Agricultural Experiment Station for 1896.

The Influence of Subsoiling on Soil Moisture.

(14) Kansas Agricultural Experiment Station Bulletin No.68

The Conservation of Soil Moisture.

(15) Report of the Ontario Agricultural College and Experiment Farms for 1897.

Capillary Rise of water in Soils.

(16) Report of the Wisconsin Agricultural Experiment Station for 1897.

The Percentage of Water Retained by Sandy and Loose Soils.

(17)Wyoming Agricultural Experiment Station Bulletin No.35.

The water content of prairie sod and of cultivated land compared.

(18)Report of the Wisconsin Agricultural Experiment Station for 1898.

The effect of early v.s. late spring tillage on the moisture content of soils. Also the effect of Mulches on the moisture content. (Good)

(19)Report of the Ontario Agricultural College and Experiment Farms for 1898.

The effect of surface cultivation on soil moisture and a determination of the amount of moisture.

(20)Michigan Agricultural Experiment Station Bulletin No.164.

The effect of tillage on the moisture conditions of plots of oats, corn, wheat, and clover. (Good)

(21)Kansas Agricultural Experiment Station Bulletin No.89.

The effects of culture on moisture conditions.

(22)North Dakota Agricultural Experiment Station Bulletin No.38

The effects of fall plowing and other methods of culture, on wheat and on the moisture content of the soil.

(23)Report of the Colorado Agricultural Experiment Station for 1898.

The Campbell method of the conservation of moisture tested with many crops.

(24)Minnesota Agricultural Experiment Station Bulletin No.68.

Growth of weeds as affecting soil moisture.

Tillage as affecting soil moisture.

The moisture content of land studied under different conditions; vix., surface cultivation, mulching, plowed, plowed and subsoiled etc.

(25)Kansas Experiment Station Bulletin No.99

Early Plowing and Moisture Conservation.

(26)Report of Ontario Agricultural College and Experiment Farms for 1899.

Surface cultivation and moisture content.

(27)Report of the Tennessee Agricultural Experiment Station for 1899.

The Interrelationship of plowing and moisture.

(28)Oklahoma Agricultural Experiment Station Bulletin No.47.

The Moisture content of wheat soil.

(29)New Mexico Agricultural Experiment Station Bulletin No.31.

A study of soil moisture on various kinds of soil.

(30)Report of Canada Experiment Farms for 1901.

The moisture content of soil as affected by clover.

(31)Wyoming Agricultural Experiment Station Bulletin No.52.

Experiments with evaporation of soil moisture and some means of retaining it.

(32)Nebraska Agricultural Experiment Station Bulletin No.79.

Orchard culture and soil moisture.

(33)Kansas Agricultural College. The Industrialist No.25.1902

The Campbell method of moisture Conservation fully discussed and explained.

(34)Kansas Agricultural College. The Industrialist, No.35.1904.

Soil Moisture Studies including,

Methods of Conservation before planting,

Comparison of fall plowing, Spring plowing and unplowed land,

Cultivation experiments with numerous crops,

Comparison of cultivated fields and grass land, etc.etc.